BAYLOR UNIVERSITY BULLETIN
VOL. IX. NO. 1

NATURE-STUDY AND BIOLOGY

FOUNDED IN 1845
AT INDEPENDENCE, UNDER THE REPUBLIC OF TEXAS

JANUARY, 1906

ENTERED AT THE POST-OFFICE AT WACO, TEXAS, AS SECOND-CLASS MATTER

BAYLOR BULLETIN

Vol VII, No. 1. English in High Schools.
No. 2. Pedagogy.
No. 3. Annual Catalogue.
No. 4. President's Annual Report.

Vol. VIII, No. 1. Public School Libraries.
No. 2. Chemistry in High Schools.
No. 3. Annual Catalogue.
No. 4. Baylor Theological Seminary.

Copies sent free to those addressing the Registrar, Baylor University, Waco, Texas.

Baylor University Bulletin

PUBLISHED QUARTERLY AT WACO, TEXAS, BY

BAYLOR UNIVERSITY

AND EDITED BY THE FACULTY

HENRY LEE HARGROVE, PH D.,
EDITOR-IN-CHIEF

EDITORIAL COMMENT

The Summer School of Baylor will begin June 7 and Dr. H. L. Hargrove is again Dean.

Public School Teachers will welcome this number of the BULLETIN since it contains a very suggestive and helpful article on Nature-Study by Professor Kesler.

In the death of President Harper of the University of Chicago higher education has lost a stalwart friend. What he has done for that great seat of learning in the West is truly wonderful. Let us hope a worthy successor shall be found.

Since History is the life of yesterday and thus closely connected with the life of to-day, the teaching of this subject is of vital issue. We are pleased to announce that the April number of the BULLETIN will be written by Baylor's Professor of History, Dr. B. H. Carroll, Jr.

President S. P. Brooks has been appointed to the position of Corresponding Secretary of the Educational

Commission in the place of Dr J. M. Carroll who has resigned the work. Dr. Brooks has undertaken the work with his characteristic energy and optimism. This great work is in addition to his heavy duties as president of Baylor, but we predict he will succeed in raising the $140,000 needed this year by Baylor and the Correlated Schools.

Baylor Summer School for 1906 will be better than ever if Dean Hargrove's ideals are carried out. There will be at least five of the regular college faculty in the Summer School and in addition Professors R. G. Hall of Cleburne and J. F. McDonald of Taylor. Other teachers are being engaged and elaborate plans are being made. Special courses will be adapted to the needs of public school teachers and no doubt Superintendent Cousins will recognize this school as a state normal. Those interested should write Dean Hargrove for Announcements and particulars.

NATURE-STUDY AND BIOLOGY

Professor J. L. Kesler

The study of biology is the study of living things, plants or animals. It includes the simplest phenomena and the deepest researches after their causes. In what follows I shall try to show that the study of plants and animals not as highly specialized departments of science, but as living things making their appeal to life-sympathies and life-interests, has its value as knowledge and its value as discipline; that it is suited to the kindergarten as it is suited to the high school and college courses and to university and professional work.

While technical science is of the highest importance, and while scientific medicine is the child of the biological laboratory, these have been waived for the simpler and more vital matters that stand at the open door of every life.

I shall take the liberty of drawing freely upon an address which I delivered before the Texas Teachers' Association, December 30, 1903.

NATURE-STUDY

WHAT IS NATURE-STUDY?

Dr. Hodge in *Nature-study and Life,* clearly the best book ever written on the subject, says that it is "*Learning those things in nature that are best worth knowing, to the end of doing those things that make life most worth living.*" Had not so much been written about it one might say shortly and sharply, nature-study is the study of nature, of course—not all of it, for that were clearly impossible, but such parts of it and in such way as best suits the child's capacities, interests, needs,—such as stir within him the most evident delight and activity in right directions. It must not be technical; it must not be doctrinal; it must not try either to illustrate or establish general formulated

principles, ultimate laws, or final causes. These are out of the reach of the child. The teacher must teach the *child*—no system or schedule of nature. Everything radiates from the child's standpoint.

It should, therefore, be observational, not logistic, to the end of seeing things in their immediate relations, not their remote, with their immediate and obvious interests that make to the child a direct and personal appeal. Only such parts of nature as do make such appeal should enter into such work. The purpose is not, after the encyclopedic fashion, to exhaust the information about the object studied, and in so doing exhaust the patience, the pleasure, the interest of the child, but to touch only those things and to touch them only in such a way as to leave the child and the object good comrades. Everything must be seen and done from the child's point of view so that his interest and his pleasure shall not only be conserved but increased; so that he himself shall be enlarged by his growing affection and his wider companionship with nature. The subject-matter, therefore, must be "rich in universal human interest and value" (Hodge). There must not only be material but some satisfying answer to a natural question. In biological nature-study, the only sort we are concerned with here, the child must live with, love, and make his own the nature about him. The child with his own little garden, his dog, his plant, his pigeon, has an infinite advantage. As Hodge says, "wherever we raise a love we define a possible line of battle," e. g, the child loves a plant, the weeds appear, he wages endless and watchful war upon them. He has entered upon a new and purposeful activity. He has assumed a responsibility. He has entered into life, personal, responsible life. He is making character in right directions, what education is for and what life is for.

The standpoint of a little child is that of the family idea. "The mamma bear, the papa bear, and the baby bear" has been lisped by myriads of children because the family relation appeals to the child. The idea is repeated with a thousand variations and never a weariness with doll-babies and play-houses. It is the deepest and most sacred instinct and relation of the

child and of life. In biology this relation occurs everywhere, the relation of father and mother and child, and everywhere it is a story of surpassing interest, and everywhere it is open, more or less, to direct observation and direct experiment. And here as elsewhere we need not resort to fable or myth or childish twaddling to make the relation glow with rare splendor and awaken the keenest delights. We need only to find and help the child to find the truth. We need in this study no nature-manufacture. There are facts in plenty, wonderful, beautiful, useful, quickening the intellect, the affections, intensifying the interests and awakening the dim elusive sentiments that give to life its particular and individual flavor. While the genuine and abiding love of nature is the aim, on the one hand, of nature-study, it must not be attained through any disguise or dissembling; everything must be genuine; for, on the other hand, the aim is a true discipline as well as a true affection—a true response to the credentials of facts, true interests, true sentiments, true knowledge. Whatever facts are found, therefore, must be true facts; whatever interests developed, true interests; whatever sentiments, true sentiments; whatever knowledge, true knowledge. The contention here is that it shall not only be true but suited, that it shall justify itself on the ground of utility both for information and discipline, intellectual, moral, and aesthetic.

THE DISTINCTION BETWEEN NATURE-STUDY AND SCIENCE

Prof. Thomas H. Macbride, University of Iowa, says: "Nature-study is simply a sympathetic attempt to bring known truth concerning the natural world to the attention and comprehension of those who would learn. All that is offered in nature-study today will be, of course, in accordance with the principles of art and science; art, in so far as it pertains to the discussion of the beauty of outward form, science in all that pertains to exact detail, whether of form, history, or underlying relationship and origin. In other words, real nature-study is based upon real science. * * * Nature-study when dealing with animals is real zoölogy. It may not declare the entire

body of known scientific truth in the particular case, but at least it will in no particular contravene zoölogical fact. And so when dealing with plants; nature-study is botany so far as it goes. It is not myth, it is not nonsense, nor childish legend, it is truth, scientifically ascertained and supported, truth, simply and clearly stated."[1]

Prof. F. L. Stevens, A. and M. College, N. C., attempts to make three fundamental distinctions between nature-study and science. First, nature-study is concerned with details, science with fundamentals; second, nature-study is the study of natural objects, not books, while science may be either; third, the end of nature-study "is to increase interest, to awaken the powers of observation and to open the eyes of the child so that he may see the beauties of nature that abound unrecognized about him;" of science the end is "the acquiring and teaching of facts, laws, or principles."

Neither the first nor second of these, it seems to me, will stand the test of severe criticism, and the third needs some modification.

Prof. M. A. Bigelow, Teachers College, Columbia University, makes the following extended comparison: "Here is the difference: nature-study, which in its subject-matter is only a modern educational form of the old-time general natural history, deals with facts primarily for their own sake without particular regard to organization into a system; on the contrary, modern natural science deals with facts primarily as they stand related to organizations. Nature-study deals with the simple facts of nature as these are related to man's general interest in them; but natural science deals with facts, both general and detailed, as they fit into one vast scheme of generalizations. In nature-study for elementary and popular education the general acquaintance with natural things is essential; but in science we want facts which we can correlate and classify with other facts and so add to or illustrate principles of the science Or putting the whole matter in other words, nature-study appeals to us aesthetically and morally—we feel the value of acquaintance with natural objects and processes without perhaps being able to

[1] This and the following quotations are from Nature-Study Review, 1, 1, Jan 1905

state the reason why; but natural science appeals to us intellectually and philosophically—we measure values of facts according to their relations in our system of knowledge. We see that the difference is in the view-point, rather than in the materials; but so far as studies of nature concern the earliest stages of education and popular information it is obvious that the difference is a fundamental one."

He further says that the difference is not simply related to the amount of detail and simplicity of language, and makes the following condensed definitions: "Nature-study is primarily the simple observational study of common natural objects and processes for the sake of personal acquaintance with the things which appeal to human interest directly and independently of relations to organized science. Natural-science study is the close analytical and synthetical study of natural objects and processes primarily for the sake of obtaining knowledge of the general principles which constitute the foundation of modern science." He further says that he fails to see "any sound foundation for distinction between nature-study and natural science except on the basis of generalizations," and that in both alike the "actual study of the natural objects and processes is the one sure basis for the teaching."

It is clear that nature-study, or the natural history process should precede, in any event, the strictly scientific process. The one must gather the materials, see and feel their individual and local interests, their immediate and limited relations, their significance and uses in the smaller community of facts with which they coöperate first. Nor is this simply aesthetic and moral, but intellectual also to the brim,—a sort of reasoned science in the immediate and simple relations which shall, by and by, gradually, as life grows and vision broadens and experience of facts accumulates and the cosmic perspective comes into view, become rationalized science in the strict sense, i. e., the facts of experience, whether observational or experimental, shall shape themselves into a rational order of a wider generalization which extends into the remote and obscure. This latter may be chiefly intellectual and philosophical, but it is not devoid

of the ethical, the aesthetic, nor yet of sentiment and emotion. There is no hard and fast distinction where nature-study meets and passes into science any more than there is where the child reaches up in his growth into the measure of a man.

WHAT IS THE METHOD OF NATURE-STUDY?

It is not telling interesting stories about natural objects, though these are not prohibited. I know a little girl who listened one summer evening to the story of the ants, and the next day found her bent over an ant hill and she saw for herself the marvels of the story teller. That ant hill exhilerated her with intellectual and ethical cordials and that which was ugly suddenly became beautiful. The associations had transformed that part of the living world for her, had filled it with a moral quality. She would not hurt one. They belonged to her parish and were under her protectorate. She followed with eager interest every one of her straggling parishioners. This was nature-study and real nature-study is this extended to all natural objects.

It is not reading nature books, if it stops with the reading, and yet nature books are not prohibited. When reading leads to seeing, when the book says come and see and the reader goes and sees for himself and abides with the vision, it is nature-study.

In nature-study, as in science the eye must see and the mind exercise itself upon the thing and not stop with descriptions of it. The following is from a report to the American Association for the Advancement of Science, 1879, on the methods of scientific teaching in the public schools:

" * * * it is the first requirement of the scientific method, alike in education and in research, that the mind shall exercise its activity directly upon the subject-matter of study, otherwise scientific knowledge is an illusion and a cheat. As science is commonly pursued in book descriptions, the learners cannot even identify the things they read about. As remarked by Agassiz, 'The pupil studies nature in the school-room, and when he goes out of doors he cannot find her' This mode of teaching science * * * has been condemned in the most

unsparing manner by all eminent scientific men as a 'deception,' a 'fraud,' and an 'outrage upon the minds of the young,' and an 'imposture in education.' "

In any school, of whatever grade, where "botany" and "zoölogy" are taught without plants and animals, with a book as the chief reliance, I recommend that the study be immediately discontinued till the plants and animals can be secured and studied directly. An ounce of seeing things is worth a car-load of description without it.

The child must in all cases be made to participate in all the means of getting knowledge in order that he may also obtain the discipline, and that he may love the work. It isn't a task for the child to go hunting things in nature, it's a picnic. Only he should not be sent too often on hopeless errands. What he goes for should mostly be easy to find. But he can have suggestions to be on the lookout for things to sharpen his eyes and his wits, and to put purpose into his seeing.

The first thing to do on beginning any individual study is to take stock of the child's mind. He will be only too glad to show his wares. This should be written and put on file. It will prove valuable information. It is not called for to kill time. It is to be used. It is a genuine and essential part of the business. In this way the teacher gets the child's standpoint and his already intellectual possessions, a necessity in all proper teaching. From these as starters the teacher may lead out to many an observation and many a new experience.

The child's own observations and experiences must be the basis, but the teacher will find opportunity to go quite beyond these on account of the rich suggestions and associations that lie in solution in the problems already solved. Indeed she could hardly escape it, if the teaching be successful, and the teacher have, as she ought to have, an open joyous heart to the storm of impetuous questions and the impetuous questioners.

As to hard, or technical names, we should neither run after them nor avoid them. They are as easy as any other names. They are simply new, that's all. We must avoid thinking, however, that we have learned science when we have learned a new

name. We need the name only after we know the thing to which it belongs. If we have a bundle of names and no familiar facts to correspond, we have simply assumed an unnecessary and unremunerative burden. We have made no advance at all. Quite the contrary.

WHEN SHOULD NATURE-STUDY BEGIN?

The following from a report to the American Society of Naturalists in 1888 will sufficiently answer this question. Natural science here is clearly used in the sense of nature-study as defined above.

"Instruction in natural science should commence in the lowest grades of the primary schools and should continue throughout the curriculum . . . ."

"In the primary schools and in the lower grades of the grammar schools we would recommend that the study of plants and animals should be the main part of the scientific work."

And again from a later report:

"By so many years of exclusive attention to other subjects, their powers of observation and of imagination of physical phenomena are well-nigh atrophied; and the loving interest in nature, innate in every normal child, instead of being systematically developed, is well-nigh extinguished.

"The remedy for this state of things is to be found in the introduction of elementary lessons of science at a much earlier period of the course. We believe that the study of nature should begin in the primary school, and should continue, in increasingly systematic and philosophic methods, through all grades of the educational system. We beleive that, in the light of sound principles of pedagogics, a system of education must be pronounced radically defective which fails to gratify and stimulate the curiosity of children in regard to things about them and within them. . . . ."

These quotations embody the opinions of leading men of science both in England and America, expressed both before and after the above dates. The one thing here to be on guard against, however, is a sort of pseudo-science which often takes

the place, and sometimes assumes the name, of nature-study. This nature manufacture, for it is nothing else, both inoculates the mind of the child with false methods and misty inaccu racies and fills it with sentimentality instead of healthy sentiment and sympathy; and, in this way, prepares ineradicable mischief.

WHERE SHOULD NATURE-STUDY BE INTRODUCED?

Wherever there are children and there is a teacher who loves nature. If she does not love nature she cannot teach it to the child. If she says, or can say, I hate it, I hate to teach, her life is a reproach and a crime in the way of the life of the child. Her confessed limitations would force her to retire from the school-room. The lack of knowledge on the part of teachers is a serious matter, but the lack of sympathy and interest are still more serious.

I hardly need to use the word "introduced," for nature-study is no new thing, though the proper direction of it is. Like child-study, it has become a new fad in the mouths of those who mistake a new name-combination for a new fact. Just as child-study, with no fuss about it and no piping pedagogue with quill and note-book, has been the chief delight and the chief educational influence in the life of the mother and child-lover everywhere since Moses lay in the bulrushes and since Mary "kept all these things, and pondered them in her heart," as it is written, so nature study has been with us all the time. It has been the chief factor in stimulating the intellect, in satisfying the natural craving for beauty, in forming the moral ideals of the race, in making the mind alert and the will strong, even from the first. And, from the beginning, following the line of ancestral progress and repeating in his unconscious instinct the history of the race, the child fumbles with nature and asks more questions than he gets answered by his elders in a civil, not to say an educational way. This vocation of nature-study is entirely normal and will continue to be a chief factor in development, call it natural history or what we may, if it be not checked by artificial schemes of schools and pedagogues. The child raised

up in the woods with his natural needs of intellectual and emotional activity satisfied with natural objects, without school opportunities, has sometimes the advantage of the child who has spent some years in a school where he has been weaned away from his real mother-life in the woods—the life with the genuine spring in it, the life intellectual, moral, aesthetic, dominated by an independent, if not an irascible will. He may lack the polish, but he has the power; there may be volcanic outbursts that do not fit polite society, but it is because there are moral fires beneath that rural mountain.

The old natural history, which was genuine at all, was nothing else than nature-study; and we cannot afford to skip that phase of our science-teaching today, the city school least of all. The country supplies with daily contacts the daily natural needs; in the city the school must supply what the city has lost, the laboratory being a greater necessity in an artificial life.

When the emotional stroma of a wide sympathy and acquaintance with vital facts for their own sake and on account of their immediate relations shall retire from science it will leave it a stranded scholasticism as bare and lifeless as ever was left on the shores of the extinct sea of the scholastic middle ages. Many a biologist today is nothing but a shop-hand, a mere technician, for lack of this early training of the sympathies, the insights, the wider interests and vitalities of his subject. He fits his facts, which he values all too highly because he knows no other, into another man's scheme, a scheme which he is neither able to criticise nor mend because of his narrow perspective. But most students never go to college and for them nature-study or natural history, if you will, with some first-hand observational and experimental knowledge of living things is absolutely imperative.

WHAT EQUIPMENT IS NECESSARY FOR NATURE-STUDY?

Happily nature has looked after that, for the most part, out of doors, but occasionally some of the outside material will have to be moved inside for convenience This will require a few aquaria for tadpoles, fishes, nymphs of dragon-flies, water-snails,

water-plants, and the like. These can be made of zinc or tin or of wood made water-tight. Convenient sizes are 16x24x6 inches, and 12x16x6 inches. I have used large dish-pans in default of anything better, also pickle-bottles, fruit-jars, etc. A few insect-cages also will be needed for keeping alive or developing insects. These can be made of ordinary door-screen material by bending it into a cylinder, sewing it together with a wire unraveled from the gauze, closing one end with a disc of the same material, and slipping the open end, with the insects enclosed, down over a plant-pot, or box, containing the plants upon which they are to feed. Care must be taken to make the diameter the right dimension to fit the pot or box closely. Besides these, plant-boxes, flower-pots, bottles, test-tubes, a few mignifiers, and other simple apparatus that can be improvised when needed.

For the science courses in the high school, however, a laboratory is indispensable. Without this and its proper equipment science work is done, if done at all, at a great disadvantage. This laboratory should be large enough to prevent crowding, should be well-lighted—north light is best, but it is not indispensable—there should be tables, of course, water, and gas. There should be a place for storing apparatus and materials. Each student should have a locker for his individual apparatus, note-books, ink, etc. The apparatus should be simple—such as scalpel, forceps, scissors, dissecting needles, and magnifier. For any work above nature-study, and for some phases of nature-study also, the individual use of a compound microscope is necessary. Each student should have locker and key and be made responsible for all of his instruments, a deposit fee being held for their return in good condition. The compound microscope can be used by more than one student provided their laboratory periods are at different hours. Laboratory periods should be two hours long where the schedule of recitations makes this possible. Details for the collection, purchase, and preservation of materials can be obtained from most of the elementary books on this subject. Some valuable suggestions are given in *The Teaching of Biology* by Lloyd & Bigelow in Chaps. IX.

During the high school course of four years, at least two years of five hours a week should be devoted to biology, a part of the time to study out of doors This presupposes considerable advancement already in interest, methods, and knowledge on account of the nature-study in the lower grades. The time should be devoted to plants, animals, and human physiology. The plants and animals, it seems to me, should now begin with algae and protozea and advance to more complex forms. The physiology should contain just enough anatomy to maks the physiological, hygienic, and sanitary processes available to the student. The basis of the teaching should be simple experiments. The experiments should be made by the students themselves and should occupy the greater part of the time devoted to these subjects. Whatever is taught about the use of tobacco and alcohol should be demonstrable science and not a propaganda of opinion. It should be, and it should appear to be, an integral part of science, not something dragged in by force and not a pedagogical preaching A false claim defeats all claims. A moderate, true, and demonstrable claim commands respect and obedience This course should not be planned as a preparation for college, but as a preparation for life, though the college might accept it in lieu of so much Latin or Greek or other subject as entrance requirement

WHAT ARE THE MATERIALS OF NATURE STUDY?

Just what the peculiar materials should be will be determined by the most common of the suitable materials of the neighborhood They need not be the same in any two years or in any two places They can be varied indefinitely without disadvantage, though some suggestions may be made as to selecting groups of objects These must always be close to the everyday interests of the average man, though sometimes they may be far removed from the average man's knowledge Certainly no systematic arrangement should enter into the choice

Having the widest scope of all subjects of a scientific nature, this study can choose the materials best suited to all needs. Here it may touch the profoundest problems of the race and

heal the evils while still they ripple in the springs of life, supplanting ignorant insinuations by wholesome truth, not by a preaching, not by a hint at life's failures and forfeits, but by the most natural and most necessary teaching of the deepest and sanest and most integral centres of radiating vitality so that all the vital processes for the renewing of the race shall not only be, but appear to be, holy and thus rob half of life of its veneer of vulgarity and fill it with "sweetness and light" and cleanness and purity and divine affection.

Children are by nature active, and if their activity be not directed into constructive enterprise, it will fall into destructive enterprise; for enterprise the child has and it is seen at its highest in his play. The child does not need repression but direction. Let him have some living thing to tend, something that he loves and can love well. Let it be his property that he may fulfill his nature and come into his own. Property-rights of others are recognized and developed by some personal and actual responsible ownership. Care for one's own and effort in its behalf cultivates both a proper appreciation of values and respect for the property of others. Lacking space here for even the beginning of this discussion, I must refer the reader to Hodge's *Nature-Study and Life,* every page of which is pure gold and should not only be read by teachers, but by parents as well. In Texas many of the plants and animals suggested will have to be replaced by others, but that is a matter of such minor importance that it does not at all detract from the value of the book.

The primary principle, in a word, is to begin nearest to the child's heart, with his pets, then insects of the house and the garden, those that are beneficial, and those that are hurtful, beautiful, and wonderful, their friends and enemies, their life-cycles, their depredations, their diseases, their far-reaching influence as bearers of disease, and the means of their extermination—bird-neighbors, physiology, hygiene, and health; and plants of the home and school garden, beautiful and useful, how to grow them, their enemies and diseases, and how nature with the help of the child can come to their rescue, the many symbiotic rela-

tions, the relations of insects and flowers, of the rhizomorpha and bacteria to higher plants, parasitism, galls and their inhabitants, disease and sanitation—what a field for enthusiasm and for teaching life-lessons, the teaching not limited to schedules, but in season and out of season—here a little and there a little. The field is the world and it is white unto harvest. And all this can be done with inexhaustible interest and invaluable increase of necessary knowledge, with practically no apparatus, with only the child's senses and the child's open heart and mind facing raw nature, provided a teacher is forthcoming whose sympathies and interests are both with the child and the world of knowledge, and whose day's work is not done at three o'clock in the afternoon.

BIOLOGY

Biology, both as nature-study and science, has, as all subjects worth studying at all have, two values, a value as knowledge and a value as discipline.

THE IMPORTANCE OF BIOLOGY AS KNOWLEDGE

Of the great variety of topics that might be discussed with equal propriety under this head we must be content with two, agriculture and health,—leaving out the most important of all, perhaps, the relation of biological knowledge to the intellectual problems of our time in philosophy and history and religion; also, its necessity in the preparation for the profession of medicine and all the arts of healing.

AGRICULTURE

Agriculture here is used in its widest meaning, including all the interests of farm, garden, orchard, and forest. The revolution in our methods of getting a living from the soil, still in its infancy, but promising to multiply the possibilities of life and ameliorate the conditions of many; the insect pests which in the United States alone cost us upwards of $400,000,000 annually and fungal and bacterial diseases of plants which cost us still more—the smuts alone reaching $200,000,000, the rusts perhaps twice that much, and others innumerable and destruc-

tive, forests laid waste and millions of timber lost through fungal diseases,—orchards, fruit gardens, truck farms—all these lay their tribute at the feet of biology and look hither for help. The gypsy-moth devastating great areas, the plague of the locust, the coddling moth, the blights and the mildews—but time fails me and the figures stagger our conceptions—the very enormity of the problems set for biology in agriculture strike us dumb. But what has already been accomplished gives hope that biology will push still further her vital craft.

In the following details, to speak briefly, it is well known how the nitrogen gathering bacteria, sent out in small packages, grown in nutrient solutions, sown with the seed, both multiply the harvest of clover and enrich the soil; how, also, we may now intelligently feed for fat, for lean, or for milk; how many diseases, which used to decimate domestic animals and plants, have been rendered practically harmless, e. g., Texas cattle fever, and anthrax; how microscopic meat inspection has added $2,500,000 annually to our foreign market; how irrigation makes the thorn desert blossom as the rose; how the first crop of clover seed fails for lack of the fertilizing bumble bee; how Smyrna fig culture was introduced into this country by aid of the fig insect, the blastophaga; how within the last ten years, up to two years ago, Texas rice fields had grown to 570,000 acres, with $26,000,000 invested in canals and machinery, producing annually 4,000,000 barrels of rice, worth $15,500,000. How far these figures fall behind the facts today, I am not able to say, but these and other advances must be put largely to the biological account. Indeed, to follow the lead of biological knowledge is the crown and goal of agriculture, the fundamental art of all the ages This is an inadequate statement and but hints at the facts, but space puts its inevitable veto on any further elaboration whatsoever

HEALTH

William T Sedgewick, in speaking of physiology and hygiene, says, that "it is doubtful whether any subject in the whole realm of public schools is of greater intrinsic importance as a

preparation for life, or is capable of affecting more profoundly the whole mental attitude of men and women toward an enduring and well organized civilization."

The revolution in our notions of the cause, the treatment, and the prevention of disease by proper sanitary measures separates our age from every other and adds a new responsibility.

The need of biological education in order that the people may be in sympathy with strict sanitary practice, and intelligent with reference to the recent triumphs of biology in the methods of prevention of disease—already liberating them from many evils, multiplying their comforts, and increasing their happiness—needs no detailed proof. Over thirty years ago, Herbert Spencer, in his epoch making essay on *Education,* made, in my judgment, the true indictment: "To tens of thousands that are killed, add hundreds of thousands that survive with feeble constitutions, and millions that grow up with constitutions not so strong as they should be; and you will have some idea of the curse inflicted on their offspring by parents ignorant of the laws of life. * * * When sons and daughters grow up sickly and feeble, parents commonly regard the event as a misfortunte—as a visitation of Providence. Thinking after the prevailing chaotic fashion, they assume that these evils come without causes; or that the causes are supernatural. Nothing of the kind. * * * Very generally the parents themselves are responsible for all this pain, this debility, this depression, this misery * * * in utter ignorance of the simplest physiologic laws, they have been year by year undermining the constitution of their children; and have so inflicted disease and premature death, not only on them but on their descendants."

And it is still as true today as ever it was, that the people perish for lack of knowledge

According to the census of 1900, while only 12 1 per cent. of the population of the United States are under five years of age, the mortality rate under that age is 30.7 per cent. of all the deaths recorded. In Texas 40 7 per cent. of all the deaths among the white population are under five years old; and this rises to 46 7 per cent in the Indian Territory—almost one-

half the deaths occur under five years of age. And yet, we are told, this is better than it used to be. In the leading cities of the world, with one or two exceptions, the mortality in the first year of childhood exceeds 25 per cent. of the total mortality of the total population. What will the future call us! What defense can it offer when we are charged with infanticide of deeper dye than that of Herod? What can be said if we neglect the aseptic knowledge at hand which balks the seeds of death? How can we make further progress till we use the knowledge we have? Not a third, not a fourth of the children buried annually have and need to die. Buffalo, New York, by the efforts of a single man in a single city, unaided and alone, by keeping daily accounts with the birth register and by immediately furnishing to mothers intelligent information about nutrition, disinfection, and the like, saved in a single year 1,500 infant lives and reduced the infant death rate one-half. Is not this proof that the people perish for lack of knowledge? And yet we hear the questions: "Why should a girl study science?" "What need has she of physiology?" These questions are simply pathetic. They show how suicidal and how densely dark are the shadows of ignorance. Humanity has here a fearful responsibility. Who shall paint the holocaust of infant lives, not to inevitable but to invited disease and death! Is the propaganda of biology here less than a missionary labor? Is her evangel less than divine? Let that monk's hood, bathed in classic ether, count the value of human life and health before he refuse to dip his hands into this living stream.

In Europe and America are prostrated annually by disease 70,000,000 people, 3,000,000 die; 45 per cent of these deaths are due to preventable diseases; most of the prostrations, the consequent loss of time and money, the pain and waiting, the impaired health and weakened constitutions, could be prevented by proper hygiene and sanitary practice. The knowledge has been gained by which this needless pain and death may be avoided Isn't it reasonable to say that a general education should put the people within reach of the appreciation and use

of these majestic strides of the human intellect and mastery of nature? Ought not a general education to put the public into posessession of the knowledge which will help them to use whatsoever of these advantages are within their reach? Here are valuable facts on which the lives of all may bank for health and happiness—a part of the rightful inheritance of our race, a part of our birth-right—to come into possession of which needs only a little biological training.

Not that all should be skilled in the technical requirements of the pathological laboratory; not that all should be taught medicine; not even the specific causes of the many diseases in any technical way; not even should they enter into the more fundamental and obscure problems of biology at all; but that the general and well attested principles of biology should put all the people into intelligent responsiveness to the proper conduct of life and its relation to general hygiene and preventable infections; that all should know how to conserve their health, how to avoid infection, how to disinfect and when. What I insist on is that all the people should be infected with this general biological contagion, this intellectual vaccination against disease, this mental antiseptic and immunity. Leaving the knowledge of the laws of life alone to the priests of medicine to whom we make pious confession after each sanitary debauch will never remove effectually our sanitary sins. Not even shall the absolution of the high priest atone for our physiological mistakes. Only when the universal intelligence and the universal practice of sanitation shall become the fashion, shall become ingrained in the daily private and public life, and when, in addition, we shall leave off patent quackery and employ the physician for guidance rather than healing, shall we, invigorate and virile, commune face to face with the god of health This time will never come till, at least, the general facts of biology are incorporated in the general mind; and the one practical way to reach the multitudes in time to insure conduct is through the schools, and, in part, through the lower schools

The sociological problems have their basis in the biological and look hither for help; and, in like manner, the biological

reach up into the sociological. Here, as elsewhere, no man lives to himself. The problems of sanitation are not only individual but corporate; they involve the city, the state, the nation, and *inter*-nations. They involve votes and laws and law-abiding. They demand intelligent citizenship—citizens who know something of the dangers of food adulteration and parasitology; of municipal, national, and international sanitation. The citizen today holds human lives in his ballot. Pity that he should know so little how to use it! The individual alone cannot free himself from the tangle-web of mortality woven by many hands; only in the corporate union of all shall the threads dissolve away, and Grendel of the wide death-marshes sleep.

I am not saying that death is not inevitable, that bodily ailments will not be here to plague even the sanitary saints in any future sanitary millennium whatsoever; but I do say that 45 per cent. of the diseases and deaths that make life bitter and the world desolate can and ought to be abolished, and, further, that some biological knowledge paves this foot-path to peace, that reform here can come only through an educated community, and educated somewhat in the biological sciences.

It cannot but concern everyone individually to know something about the hygiene of exercise, fatigue, rest, work, play, hunger, thirst, sleep, growth, age; of clothing and bathing; of sight and hearing; of wholesome homes and pure food, of purification of water and sewage; of scavenging and garbage destruction; of ventilating; of disinfecting rooms, clothing, books; of school inspection for sanitary purposes; of public hospitals for isolating contagious diseases—and, indeed, everything which tends to make life wholesome and whole. My contention at this point, however, is that these things not only concern the individual, but the community.

The problem of the tenement house and legislation, the problem of water supply and legislation, the problem of pure food and legislation, the problem of sewage disposal and legislation, the problem of quarantine and legislation, the problem of eradicating the carriers of disease and legislation press upon

us today as never before. Moreover, it is everywhere being demonstrated that mortality from contagion is in inverse ratio to the stringency of the preventive measures intelligently enforced: witness small pox and yellow fever. It is certain that the care of the public health is becoming more and more an important function of the government. More and more the means of travel spread disease; more and more must we be alert to thwart its entrance into the human body, and suitably provide for its isolation and healing. In France the schools are both inspected and disinfected monthly. The pupils are examined and any with contagious diseases, as consumption, are removed from school. All books handled by such pupils are burned and the school disinfected. Why should we be behind in this respect? When shall we have such provision? Not until the people are awake to their needs. Not until they know that their children hazard their lives in the tender age when they are especially susceptible. Unless the parents do know and see the dangers and feel the responsibility of providing for the safety of the lives of their children by proper school inspection, isolation, and disinfection, no such regulations are possible. No means of prevention of disease which call for an outlay of public money, no enforced precautions are possible till we *know*. Knowledge is primary—general knowledge which reaches and commands the people, all the people.

Fifty years ago Japan was hardly considered civilized; today she is abreast of the world. Upwards of a year ago Major General Seaman of the United States army was there and the authorities said to him:

"Russia may be able to place 2,000,000 men in the field. We can furnish 500,000. You know in every war four men die of disease for every one who falls from bullets. That will be the position of Russia in this war. We propose to eliminate disease as a factor. Every man who dies in our army must fall on the field of battle. In this way shall we neutralize the superiority of the Russian numbers and stand on a comparatively equal footing."

Up to that time of the thousands of wounded soldiers trans-

ported to Tokyo, not one had died, and in the hospitals on the field of carnage the wounded were clean and sound and healing, and so it was to the end. The surgeons and nurses had done their work so well that nature and pure food and proper hygiene did the rest.

He found the medical officer everywhere, front and rear—ahead with microscope and chemicals, testing water, labeling wells, examining sanitary conditions, quarantining against infection; in the camp, making microscopic blood tests in fevers; at headquarters, bacteriological experts, equipped, and doing expert work; in all foraging parties, food, water, fruit tested by experts, suspected water ordered to be boiled and fruit to be cooked, and officers detailed to see that these orders were carried out; in every camp, medical officers lecturing on hygiene—how to cook, to eat, to drink, to bathe, how even to clean the finger nails to prevent bacterial contagion; at home, food inspection of all army supplies so that intestinal fevers, diarrhoeas, and dysinteries were almost entirely absent from the army.

Contrast that army with ours and our neglected sanitation and hygiene in national, local, and individual life!

It was the summer of '98. I rode on a train with a company of soldiers from Missouri to Georgia. A gay lot of fellows they were as they went out It's too long and too sad a story to tell of the camps of Porto Rico, Tampa, and Chattanooga.

A few weeks thereafter I spent three days at Chattanooga. Twenty or thirty thousand brave men never to see the flag lifted on the battlefield and never to fire a bullet, yet the dead were there. Shall I ever forget that slain army—that city of white cots and white-aproned nurses!

On the night I left I walked between two railroad tracks and on each side for a long, long way were ambulance cars with pale, emaciated forms covered with white sheets. These were convalescents. They were starting on a long journey home, to carry with them, alas, and to scatter the germs of typhoid fever!

Two hundred and fifty thousand responded to our country's

call. In six weeks half of them were prostrated with intestinal and contagious disease, eating uninspected pork and beans and embalmed food; three thousand died because of neglect or incompetence; seventy-five thousand, one-third, were invalided and swell today that endless pension list. Fourteen Americans in that war died of fever for every one who fell on the battlefield. Why this contrast? The one employed scientific knowledge, fore and aft, in all its details and gave it power not only to instruct but to enforce its instruction, the other didn't. In this is the lesson, the lesson of eliminating disease as a factor.

That scourge of death that withered an American army on American soil, started from a single case; the excreta were not even disinfected, but exposed whence flies' feet carried the contagion to tent and table, wasted the life and left a blot on the national honor. That such were possible, with our present knowledge, is no less than a national disgrace and a national crime.

Still in schools and orphanages and cities typhoid insinuates its swart form and lays hot hands on cold graves. This is entirely preventable. Somebody is responsible. Who?

How many of the teachers of our public schools know the first principles of hygiene, health, the cause and prevention of the common contagious diseases? The lack of such knowledge endangers both their own and the children's lives and opens the way to endless paths of pain. These things can be known without technical science, they can be taught without it. I commend to everyone who reads this Wm. T. Sedgwick's *Principles of Sanitary Science and Public Health,* and Sternberg's *Infection and Immunity.* Whoever is preparing for life must needs prepare to meet the issues of life and disease, like some great Apolyon, strides everywhere across its pathway, and since but few ever go to college and yet every one needs this information, it should be taught, even if only in the simplest way, in our public schools. It can be taught along with nature-study, and be taught in a most effective and practical way.

THE IMPORTANCE OF BIOLOGY AS DISCIPLINE

Every subject worth studying at all has two values: its value as knowledge and its value as discipline. I have thus far spoken of the study of biology solely in regard to its value as knowledge. And in this I have kept intentionally to the lowest plane, the plane of the physical life—the lowest, 'tis true; but, nevertheless, I think we shall all agree that it is fundamental, that it is the plane upon which the whole superstructure of the noblest life is builded. You will recall with me, perhaps, how Herbart in his *Science of Education* says that "the basis of all disposition is physical health." And disposition, I submit, is character. And we shall do well to consider that all psychological phenomena and all social science—the problems of mind and morals, sociology and religion; that our intellectual disciplines and moral heights; that our ethical judgments and aesthetic delights; and that even the roseate flower of poesy, high over all, have each their source and crown in the lowly processes, if you like, of common physiology. Nor these, nor literature, nor life can be properly understood or interpreted in the lengthening shadows unilluminated by the light of biology. Modern literature needs biology as ancient literature mythology as interpretative material, e g, the poetry of Browning and Tennyson

While discussing the value of biology as knowledge, though I have chosen deliberately to stick to this narrow path, in reality I am not unaware of the fact that biology ministers to the whole of life; that it satisfies a natural intellectual craving; that it ministers to the spirit; that it meets a moral need and crowns it with religion; that it brings its perpetual interest; that it has a value for all men in all stages of development for all time; that its lowest branches bend with fruit in reach of the child while its highest bloom and fruit above the stars. Indeed, in its central position there is no faculty of the mind that it does not touch and refresh and heighten and recuperate right well with its cordials. I do not claim, in this matter of discipline, that biology has exclusive possession of the field, or

that other disciplines have not also their relative values. I do say, however: ask if a subject has any value as knowledge, as something to be used, proximately or ultimately. If none, discard it. Everything must justify itself by its uses or sink beneath its own reproaches. I say further, if some other subject has more value as knowledge and equal value as discipline, it has more credits to its account and must take precedence in educational values. Discipline can be gained in useful pursuits and the more useful as well as in the pursuit of phantoms and the less useful. Those who like may chew gum to develop the masseter muscle, but the most of us shall choose to accomplish the same end by masticating nourishing food. In this however, I say nothing against any other knowledge or symbol of knowledge—language merely as language is only symbol—it is not knowledge, The pity is that it should stop so often this side of the realities, the knowledge, the literature and life to which it leads or ought to lead; but as an instrument to enter into these treasures of life whose stalwart sons still make us men, it is a great factor in education. But that which used to be the main discipline when the main content of valuable knowledge was contained therein; and when, in addition, the modern treasury was empty, must give place to other equally valuable disciplines now when the richer treasuries of modern life are overflowing.

All pursuits, in school and out, have their appropriate discipline. As Thoreau said, "The wood-sawyer, through his effort to do his work well, becomes not only a better wood-sawyer, but measurably a better *man.*" Our educational task here, then, in regard to general education, is to choose, among educational subjects, the knowledge of most general worth which yields the particular desirable and suitable discipline. Now, biology is one of the subjects whose acknowledged practical worth—a worth by no means inconsiderable—concerns every human being everywhere. The only inquiry remaining, therefore, is that of the worth of its culture, its discipline. All work tends to develop skill and power in the particular faculties exercised thereby, and all work *well done* likewise has

a moral value in the development of nobility of character—reliableness, honesty, and worth in the apprentice himself—along with the ability for application, painstaking, patience, persistence, and sustained attention. It is certain, also, that this discipline which the student gets out of his task *well done* depends, in large measure, on the interest and happiness which he brings to it. In proposing educational tasks, therefore, if education is to fit for life, for complete living, we shall do well to ask Herbart's question, "how will the known parts of interest probably *continue to live on with us* in future years?" Living objects have, I submit, a perennial interest, an interest for the young child as for the white haired scholar. They command not only the attention and concern but also the liveliest sympathy of all people of all ages who are unspoiled, who have not had their natural appetites debauched with artificial pabulum. They stimulate the simplest curiosity and satisfy the needs of the most profound intellectual explorer; they have for the child the unfailing interest of simple story, for the philosopher the majestic sweep of life's deep meaning and mystery. In these vital studies, "day boils * * * Boils, pure gold, * * *" and night thickens with no answering star.

More briefly, its relation to several particular disciplines.

First, the powers of observation and the habit of observation are cultivated in the highest degree. Upon these powers and upon this habit depend largely the successes in every human activity—the farmer, the lawyer, the doctor, the teacher, the poet, the artist, each succeeds in proportion as he is a good observer. The seeing and the seer are united in one person. A good observer is not only one who can see but one who habitually does see. This observation and the inalienable sympathy which coheres in the habit, "the movements by which we make every moment of time our own—*through which we properly live*"—arise out of the discovered interests and fellowships which by thousands throng the loneliest path for him who has eyesight and insight. The student feels a certain posession in the things he has collected and observed, dissected and classified, whose habits and history he knows, whose form and

function, differentiation and beauty. This is one of the most noticeable things in natural history study, how knowledge increases the sense of possession. This *capacity* of seeing and this *habit* of seeing alike come about by looking, looking for something, something definite, till it is seen, sketched, described,—*communicated;* for nothing is well known till well expressed—and here is a distinct discipline in rational composition. In this way the blind eyes are healed and the new heavens and new earth of Elijah come into view.

Not alone the path in the desert or the reeds by the river, but also the limestone, the fern-marked shale, the exposed bluff, the quarry, the mine are full of biological interest. The ancient and curious ancestors of the living are there, and so not only to the geologist but also to the biologist the rocks and the hills cry out.

In this habit of observation the attention is cultivated as nowhere else. At first limited, evanescent, vascillating, whimsical, it grows to be intensive, persistent, sustained, and habitual. And it is the attention which measures the capacity of the mind. It holds the mental flame on the most refractory object till it dissolves and clarifies.

Patience becomes habitual also because interest and attention have made persistent effort delightful This, however, is the very atmosphere of intellectual growth. And since this interest, this novelty, this intellectual hunting and trapping on the frontier, are inexhaustible, they become the means of perpetual intellectual youth. Look at the great scientists, and others whose minds sought ever new concentrations, neither did their eyes grow dim nor was their natural force abated. Mind grows old only when interest wanes and the flowers of memory and imagination fade.

Second, of memory it is necessary to speak but briefly. Herbert Spencer has already shown that in quantity of suitable material for the cultivation of the memory it equals language study and in quality it exceeds it in educational value. It is unnecessary to stop to recount the several millions of known species of animals and plants which are increasing at the rate

of several hundreds a year. Here the name is not learned for the sake of the word but for the sake of its uses,—what names and lauguage exist for, communication, to receive or give forth information, sympathy, sentiment The name does not precede but follows immediately the knowledge of the object and is directly associated therewith, as the form with the function. It is so a memory not of accidental, but of necessary, organic, and inherent relations. In this way confoiming to the laws of interest and association, this power becomes selective, rational, permanent. It feeds on realities and not the thin air of verbal abstractions.

Third, the judgment is likewise exercised. The mind will not rest here with the jumbled facts of experience. These are being accumulated in the interesting excursions of nature-study and life. These valuable and mobile materials of memory are malleable and fluid to the imagination, are wrought and annealed in the intellectual furnace, to reappear as hypotheses, theories, and orderly systems of thought. For no sooner has the eye seen, the memory associated, the imagination held aloft its repertoire than the comparative faculty begins to discriminate and select the congruous from the incongruous, the necessary from the accidental, the essential from the superficial, the enduring from the transitory, the true from the false Over and over it sifts the materials, it tortuies and scourges them into speech, and having received a message through an exhaustive induction, in which the imagination bore the leading part, it turns straightway to verify it. This time from the central induction it goes out by radial paths to the periphery. That is to say, by deduction it arrives at certain necessary consequences of the generalization reached by the exclusive methods of induction These necessary consequences it puts to the test of experiment If the testimony here be uniform and confirmatory, the intellectual ferments, long brewing in the experimental vats, burst forth with new wine. A rare cordial this,—tonic for the gods, but it came after waiting. These exhilerating phenomena of nature and nature-study have become science It was a process of the generalization of known

facts, the coming upon a new truth, a cosmic principle, by the rationalization of known experiences. The eye sees things, but the mind will not rest with these, these ores of the senses, till they become molten and fluid in the imagination, till they group themselves and find their affinities, till they penetrate and interpenetrate each other and select the crystal form whose stability and beauty are permanent. The mind sees and demands relations and realities. It will not rest till it find these, till it brood over these, these fertilities of the senses, this germplasm; it pushes on to reflection, to truth, and the truth whose heredity binds it back to its ancestral sense lineage. These facts, phenomena, experiences accumulating in the mind with the growth of the individual, as historically with the growth of the race, are chaotic, do not always justify themselves with adequate significance, but later the intellectual activities lay hold on the void and bring order and organization out of the confusion. The time of the gathering of facts was necessary, always is necessary, and the time of developing interest was necessary, always is necessary, and for the highest result this accumulating of the facts of experience and this putting forth of nascent interest as a tender branch must come in their time, the time when the young mind is curious to know and when the knowledge fascinates and fills a natural and nascent craving. Biological study strikes all the chords that vibrate in the intellectual orchestra; at first, it may be, discordant, unconscious, confused, intermittent; it is only in the later and higher work that it looks in upon itself, becomes a fixed habit, and sets itself definite problems; it is only after experiences and in consequence of persistent and obdurate apprenticeship that the mind ever grapples long at Peniel and does not let go till the day breaketh. 'Tis here, and here only, that every Jacob becomes an Israel, because he has wrestled and prevailed—has seen God face to face. This victory of reason, first hand, shall always be the toga and insignia of the intellectual life.

Here also is another culture, this waiting for evidence, this holding the judgment in suspense, this intellectual silence. In this, honesty, persistence, and fortitude are wrought into hero-

ism, and a large morality becomes one of the assets of the study. The habitual fidelity to sight, to insight, to credentials; the complete abandonment to evidence; the subjugation of prejudice and preconceptions, as far as it is possible; the yielding up the whole life to truth and the search for truth—this has something altogether ennobling about it. This self-renunciation biology shares with the other sciences, but here there is an additional surrender in that our personal dignity and particular lineage worship must be thrown into the common budget and be weighed with the rest. Moreover the results must be accepted though they fall like a millstone on our pious egotism. This, in particular, is part of the moral discipline; that we submit to evidence as to the inevitable and hold by this and make good this at all hazards. Here to every new comer the sentry puts the question: "In what name do you come?" If in the name of evidence, welcome; if not, cast into outer darkness.

In regard to the aesthetic, poetic, and religious disciplines, I must be very brief. In reality, however, it is here that general biology is transcendent It aids materially in wresting from us our investment of enthralling superficialities and superstitions Moreover, it is itself, rightly understood, both poetic and religious The purely intellectual processes are but half the harvest. In those whose sense of music and poetry has not died entirely out of them, nature's harmony and rhythm stir the noblest emotions and lead into an enchanted land where worship is never tedious. The knowledge of the laws of life and the intimate acquaintance with some of our most common but heretofore unknown neighbors that throng the woods and fields and even crowd the streets of the most populous cities, stimulate interest and reflection, invest the old earth with a new charm, furnish the life with rare and dear companions even in the loneliest walk, protect it against the encroachment of temptations, evil thoughts, and social ennui, and are the means of incalculable happiness and health through beauty invisible to the mind uninitiated into the rare old workshop and society of nature. And looking into the deeps of life and

discovering, in the midst of the great feats of the intellect and the possibility of almost endless progress, the more or less definiteness of human limitations, the student bathed in the mists of love and mystery throned in God, is led to acknowledge that he is not the master but a participant and a part of a universal power, progress, method, mystery; and wonder, reverence, hope come to him as the angels of his workship, the laboratory. And so biology, I think, both for practical reasons and for cultural reasons claims high rank in any rational educational system.

BIOLOGY IN THE PUBLIC SCHOOLS OF TEXAS

LULA PACE, M. S.,

Instructor in Geology and Assistant in Biology

If one may judge by the work outlined in the courses of study published by the different schools, the biological work varies from almost nothing in some schools to the central line in others. Only a few catalogues were examined in detail; but they were of such schools as Dallas, Temple, Austin, and Galveston. The writer was connected with the public schools of Texas for thirteen years; and from personal experience and the experience of others, as well as from the discussions in state schools of methods and state meetings, has a general notion of what others are doing.

In this day of fads when the fad of the hour is nature-study, no school that claims to be up to date leaves it out of the course. So nature-study is begun in the first year and extends through the grades. In a few schools the course is outlined with subjects to be taught each month or each session in each grade. In many it is left for the individual teacher to select both the kind and the amount of work done. In some it is correlated with the language work, in others with the geography or reading; and others correlate reading and all language, number, and geography work with the nature-study. In all it is taught without a text save some physiology in the grammar grades, and in

a few cases some zoölogy in the upper grade.

With the great fad of nature-study in the elementary schools, and the increasing activity of the colleges in biological lines, it is a bit surprising to note how the high schools have failed to keep in touch with the thought of the hour in this particular. If they have any biology, it is usually not more than a half year each in botany and zoölogy and in a few schools a half year or a year in physiology also—all of which is elective. So it is safe to say that the majority of high school pupils have absolutely no biological training; and the few who do, get at most only three or four months of it. From their statements about laboratory work and laboratory equipments, these are, with very few exceptions, entirely lacking. In fact, one might almost be sure of the lack of laboratories from the texts used—Bailey and Bergen in botany, both of which claim to be especially adapted for schools without laboratory facilities.

In looking over the courses of study one is at once struck with the lack of definiteness in the biological work as compared with that in other lines in the same school. This may not be a fault. If it means that the school employs only well trained teachers who plan together their work so as to make a systematic whole, and yet each has greater latitude in the choice of material, it may be an advantage. But too often indefiniteness in a course means that little work is done. It always means that the amount and kind of work rests with the teacher. And if the teacher is crowded (and most teachers are) or if he has no special aptitude or training in biology (and many have not) this is the work that is omitted, or given in a haphazard way. This is the teacher who rejoices when the class gets to leaves. Now the hard hunt for new material may cease. For are there not enough shapes, and kinds of margins and vernations and venations to keep the class "busy" for weeks? All of these minute differences many become intensely interesting and helpful to the taxonomist who sees in them a means of detecting different species; but to the boy who sees nothing but endless varieties without object except to see that they differ, it becomes a weariness.

To many biologists nature-study is an abomination. For many books on the subject are not only unscientific, but are full of false statements forming the most insipid sort of fairy stories. And if one visits a schoolroom at the nature-study period, he often finds the teacher trying to get a class interested in something which would be interesting if the teacher only knew his subject and knew how to present it. Probably the greatest difficulty the teacher has is getting the right helps for himself. It is often safest to take an elementary book by a noted scientist and get hints which can be added to by personal observation—such books as Coulter's *Plant Relations* and MacDougal's *Plant Physiology*. Not that many of the nature-study books are not helpful, and that none are trustworthy, but one must be careful in choosing where there are so many that are worse than failures. But much that every teacher can make himself familiar with may be taught in the grades—the function and parts of the flower—roots and root hairs—the fundamental difference in green and non-green plants—seeds and seed dissemination—germination—trees—common wild flowers—the great groups of plants, etc., etc.; animals—their habits, structure, development, etc.; physiology—in gross anatomy and health laws. In all these the student himself should handle the material, and see everything for himself.

In the high school much time is given to physics and chemistry, and rightly so. Yet every pupil will have more or less to do with plants and animals all his life, and many of them never think of chemical formulae or laws of physics after they leave the high school. Next to the lack of well prepared teachers, the lack of well equipped laboratories is the most serious difficulty. But if the teacher has broad scholarship and is thoroughly at home in biology much good work may be done with little apparatus. For here the material with which he works is not to be bought; it is all about him. And nature is ever generous to those who understand her. But certain loboratory aids are not only very helpful, but are really essential for the best scientific work. It will be a decided advantage if there may be a sufficient number of compound microscopes for each

pupil, or for every two pupils of the class. But if this is not possible one microscope for demonstration may lead pupils to see beauties where before they had imagined only repulsive things. And with a few boxes, flower-pots, test-tubes and pans, one who knows how may be showing some of nature's most mysterious and most fascinating secrets. Where only one term can be given to botany and one to zoölogy, some teachers prefer to have both for the entire year giving one-half the week to each. This has the advantage of taking the whole year in plants and in animals; and one who has tried to teach either in a half year finds certain phases lacking that might be supplied in this way. Most high schools have gotten away from the idea that a student who has analyzed, or copied the analysis, of fifty plants and mounted them, has finished high school botany. Probably a little plant analysis may be profitably done, but this kind of work is not especially good mental drill, and has little value as science unless pursued far enough to make a taxonomist. In biology it is often better to begin with something entirely new. So if one has a compound microscope algae are much better to begin with than seed dissemination or germination. For with seeds the best students will feel that they are already familiar, and do not feel interested in what they think is an old story. While algae will open an entirely new field to them, it also begins with simple structures, and they may thus be brought to a better knowledge of the very complex structures in the higher plants. The same thing is true with animals. By beginning with some of the protozoa a new world is brought into view and a proper basis supplied for the understanding of the difficult structures of the more highly organized animals.

Whatever, little or much, is undertaken either in the grades or in the high school should be with a definite aim to give the pupils certain phases of nature's truth. This can be better accomplished if the work is systematically (not rigidly) planned, and the pupil handles the material himself, sees for himself the structures discussed, performs the experiments himself.

SHORT BOOK LIST

Hodge, C. F., Nature Study and Life; Boston, Ginn & Co., 1902, pp. 514, figs. 196 $1.50.

Thomson, J. A., The Study of Animal Life. New York, Scribner, 3rd Edition., 1896, pp. 375.

Jordan, Kellog & Heath, Animals. New York, D. Appleton & Co., 1902. $1.80.

Coulter, J. M. Plants. New York, D. Appleton & Co., 1900. $1.80.

Chapman, F. M. Bird Life. New York, D. Appleton & Co., 1897, pp. 269. $2.00.

Sedgwick, Wm. T. Principles of Sanitary science and the Public Health. New York, The Macmillan Co., 1902, pp. 387. $3.00.

Sternberg, George M. Infection and Immunity. New York, Longmans, 1904, pp. 491. $1.50.

Lloyd and Bigelow. The Teaching of Biology. New York, Longmans, 1904, pp. 491. $1.50.

Kerner and Oliver. Natural History of Plants. New York, H. Holt, 1896, 4 vols. $15.00.

Cambridge Natural History. New York, The Macmillan Co., 10 vols. $3.25 to $4.00 per volume.

Maeterlinck, Maurice. The Life of the Bee. New York, Dodd, Mead & Co., pp. 427. $1.40.

Mr. and Mrs. Peckham. Wasps, Social and Solitary. Boston, Houghton, Mifflin & Co., pp. 311. $1.50.

PERIODICALS

Nature-Study Review, 525 West 20th St., New York, monthly through the school year. $1.00.

For most valuable bulletins write to the Division of Publications, U. S. Dept. Agr., Washington, D. C., for the latest "List of Publications Available for Distribution," and apply for the "Monthly List of Publications for Sale." From these such bulletins as are desired can be ordered.

For valuable lists of books see The Teaching of Biology by Lloyd & Bigelow, Chaps. X.

"To be glad of life, because it gives you the chance to love and to work and to play and to look up at the stars . . . and to spend as much time as you can, with body and with spirit, in God's out-of-doors — these are little guide-posts on the foot-path to peace."

— Henry Van Dyke.

Prove all things; hold fast that which is good.

—I Thess. 5 21

This book is a preservation photocopy.
It is made in compliance with copyright law
and produced on acid-free archival
60# book weight paper
which meets the requirements of
ANSI/NISO Z39.48-1992 (permanence of paper)

Preservation photocopying and binding
by
Acme Bookbinding
Charlestown, Massachusetts

2000

NATURE-STUDY AND BIOLOGY

Professor J. L. Kesler

The study of biology is the study of living things, plants or animals. It includes the simplest phenomena and the deepest researches after their causes. In what follows I shall try to show that the study of plants and animals not as highly specialized departments of science, but as living things making their appeal to life-sympathies and life-interests, has its value as knowledge and its value as discipline; that it is suited to the kindergarten as it is suited to the high school and college courses and to university and professional work.

While technical science is of the highest importance, and while scientific medicine is the child of the biological laboratory, these have been waived for the simpler and more vital matters that stand at the open door of every life.

I shall take the liberty of drawing freely upon an address which I delivered before the Texas Teachers' Association, December 30, 1903.

NATURE-STUDY

WHAT IS NATURE-STUDY?

Dr. Hodge in *Nature-study and Life,* clearly the best book ever written on the subject, says that it is "*Learning those things in nature that are best worth knowing, to the end of doing those things that make life most worth living.*" Had not so much been written about it one might say shortly and sharply, nature-study is the study of nature, of course—not all of it, for that were clearly impossible, but such parts of it and in such way as best suits the child's capacities, interests, needs,—such as stir within him the most evident delight and activity in right directions. It must not be technical; it must not be doctrinal: it must not try either to illustrate or establish general formulated

CUST LOT NO	ITEM NO.	DEPARTMENT	CATEGORY	BINDING CLASS	
80702					

ACCOUNT I.D.	TITLE I.D.	COLLECTION	LEVEL
13			

NAME

Ohio St. U

BIND FREQ

[ ] SAVE TITLE (NEW) [ ] PERMANENT CHANGE

BINDING CLASS CIRCLE ONE ONLY

01 PERIODICAL CUSTOM (F+B ADS OUT)
02 PERIODICAL STANDARD (ADS IN)
03 PERIODICAL BUDGET
04 PERIODICAL LUMBIND
05 BOOK/PAPERBACK ADHESIVE BIND
(5P) PRESERV. PHOTOCOPY-ADHESIVE BIND
08 BOOK/PAPERBACK-SEWING OPTION
8C BOOK/PAPERBACK-CLASSIC RECASE

JOB 26550 SEQ 7

7

INSTRUCTIONS

2655 007

RETAIN SEWING — DO NOT TRIM
SEW THRU FOLD — BIND AS IS
ADHESIVE BIND — MOUNT COVER
OVERSEW — POCKET

SPINE LETTERING/PLEASE TYPE OR PRINT

Nature - Study And Biology

Kesler

SET OF	DATE SENT
	7/18/00

COVER COLOR	MATCH LETTERING (EXTRA CHARGE)
55	

PRINT COLOR	RUB SENT
(GOLD)	
BLACK	SAMPLE SENT
WHITE	PANEL LINES

BINDERY USE ONLY

OR	NF	HF	CF	PF
AR	AF	RR	RF	TF	TR

TOP	0	1	4	
BOTTOM	0	1	4	
FRONT	0	1	4	

BE	BS	EC	PA	
F	HA	HL	HP	
MB	MF	MS	KP	
ML	MI	OC	FP	
P	PT	SC	AT	
PC	PK	PL	PM	PO
PP	PV	P3	P5	RL
SR	SE	SW		

MANUAL BINDERY COPY 1

peals to the child. The idea is repeated with a thousand variations and never a weariness with doll-babies and play-houses. It is the deepest and most sacred instinct and relation of the